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10/580,606

05/25/2006

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EXAMINER

CRAWFORD, LATANYA N

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|--------------------------------------|--|
| Office Action Summary | Application No. 10/580,606 | Applicant(s) HARADA ET AL. | |
| | Examiner LATANYA CRAWFORD | Art Unit 2813 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 March 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 May 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>05/25/2006</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claim 22 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
3. Claim 22 recites the limitation "said formula (5)" in line 3, pp.7. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

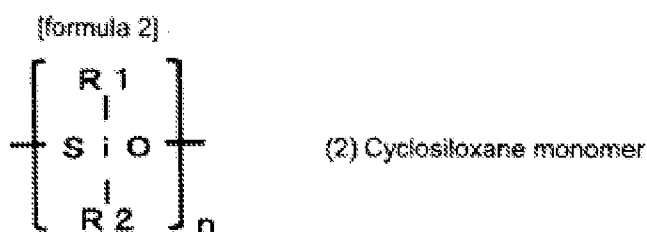
5. Claims 1, 5, & 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Gates (US Pub no. 2005/0276930 A1).

Regarding claim 1, Gates et al. discloses a method of producing a porous insulating film, comprising the step of: introducing gas containing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton, and which is

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diluted with an inert gas [0054], into plasma to grow a porous insulating film on a semiconductor substrate [0050] [0067-0069] [0078].

Regarding claim 5, Gates et al. discloses wherein said cyclic organic silica compounds are cyclosiloxane monomers represented by the following formula (2):



where R1 and R2 are respectively any one of the group consisting of hydrogen, an alkyl group, an alkoxide group, an amino group, alkene, alkyne, a phenyl group and a phenol group, provided that R1 and R2 may be the same or different, provided that at least one of the side chain groups is an unsaturated hydrocarbon group, and n is an integer of 2 or more [0054].

Regarding claim 10, Gates et al. discloses wherein said plasma is plasma of mixture gas of rare gas and oxidizer gas or hydrogenated silicon gas [0069].

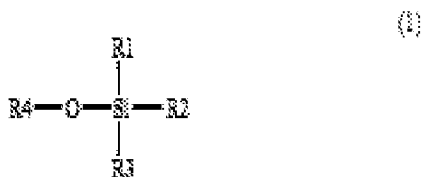
6. Claims 2-4, 30, 31, & 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Gates (US Pub no. 2005/0276930 A1).

Regarding claim 2, Gates et al. discloses a method of producing a porous insulating film, comprising the step of: introducing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton, and which is diluted with an inert gas, and vapor of straight-chain organic silica compounds, which

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have silicon and oxygen skeletons and have any one selected from the group consisting of hydrogen, a hydrocarbon group and a hydrocarbon oxide group bound with a side chain of a skeleton, and which is diluted with an inert gas, into plasma to grow a porous insulating film on a semiconductor substrate [0052][0056][0013].

Regarding claim 3, Gates et al. discloses said straight-chain organic silica compounds have a structure represented by the following formula (1):



Where R1 to R4, which may be the same or different, respectively represent any one selected from the group consisting of hydrogen, a hydrocarbon group and a hydrocarbon oxide group [0056].

Regarding claim 4, Gates et al. discloses wherein a supply ratio of said cyclic organic silica compounds to said straight-chain organic silica compounds is changed during film formation [0072].

Regarding claim 30, Gates et al. discloses a porous insulating film produced by the method of producing a porous insulating film according to claim 2[0052] [0056] [0013].

Regarding claim 31, Gates et al. discloses a semiconductor device using the porous insulating film produced by the method of claim 30 [0052] [0056] [0013] [0078].

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Regarding claim 18, Gates et al. discloses wherein said straight-chain organic silica compounds have a structure represented by said formula 1 (refer to claim 3 and [0056])

7. Claims 23, 27, & 29 are rejected under 35 U.S.C. 102(e) as being anticipated by Fujita (US Pub no. 2004/0135254 A1).

Regarding claim 23, Fujita et al. discloses a porous insulating film having a distribution of pore diameter with a single peak, wherein the specific inductive capacity is equal to or greater than 2.1 and equal to or smaller than 2.7 [0062-0063][0047] (fig. 2B).

Regarding claim 27, Fujita et al. discloses wherein a pored diameter at the maximum frequently appearance is equal to or smaller than 1 nm [0062-0063] or fig. 2B.

Regarding claim 29, Fujita et al. discloses a semiconductor device using the porous insulating film according to claim 23 as a insulating film [0047] [0049].

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

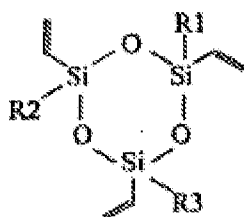
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9. Claims 6, 7, 9, 11- 16, & 19- 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gates (US Pub no. 2005/0276930 A1) in view of Miyoshi (US Pub no. 2004/0253777 A1).

Regarding claim 6, Gates et al. discloses all the claim limitations of claim 5 but fails to teach cyclic organic silica compounds are trivinylcyclotrisiloxane derivative monomers.

However, Miyoshi et al. discloses said cyclic organic silica compounds are trivinylcyclotrisiloxane derivative monomers represented by the following formula (3) [0044]:

[formula 3]



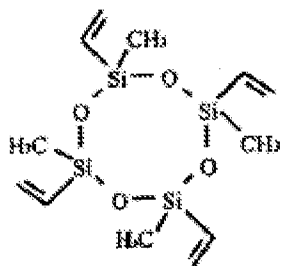
(3) Trivinylcyclotrisiloxane derivative

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the cyclic siloxane precursor of Gates et al. with cyclic organic silica compounds of trivinylcyclotrisiloxane derivative monomers as taught by Miyoshi et al. since doing so would provide an insulation film having a desired low dielectric property.

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Regarding claim 7, Miyoshi et al. discloses wherein said cyclic organic silica compound is tetravinyltetramethylcyclotetrasiloxane monomers represented by the following formula (4):

[formula 4]



(4) Tetravinyltetramethylcyclotetrasiloxane

where R1 and R2 are respectively any one of the group consisting of hydrogen, an alkyl group, an alkoxide group, an amino group, alkene, alkyne, a phenyl group and a phenol group, provided that R1 and R2 may be the same or different, provided that at least one of the side chain groups is an unsaturated hydrocarbon group, and n is an integer of 2 or more [0044].

Regarding claim 9, Miyoshi et al. discloses said plasma is plasma of rare gas [0055].

Regarding claim 11, Miyoshi et al. discloses a porous insulating film produced by the method of producing a porous insulating film according to claim 1 [0061] [0049-0050] [0064-0070].

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Regarding claim 12, Miyoshi et al discloses the porous insulating film comprising at least silicon, carbon, oxygen and hydrogen and having a Raman spectrum corresponding to at least three-membered silica skeleton in the Raman spectroscopic analysis [0044] (presumed inherent to the chemical structure of SiOCH. MPEP 2112.01).

Regarding claim 13, Miyoshi et al. discloses wherein ratios of elements in the film is: O/Si = 0.8 to 1.2, C/Si = 1.5 to 10.0 and H/Si = 4.0 to 15.0 (tetravinyltetramethylcyclo-tetrasiloxane C₁₂H₂₄O₄Si₄) [0044].

Regarding claim 14, Gates et al. teaches wherein the diameter of pores contained in the film is 3 nm or less [0043].

Regarding claim 15, Miyoshi et al. teaches at least a part of pores contained in the film have almost the same diameters as a skeleton of said cyclic organic silica compounds (presumed inherent to the compound and porous insulating film tetravinyltetramethylcyclo-tetrasiloxane C₁₂H₂₄O₄Si₄ MPEP 2112.01) [0044] .

Regarding claim 16, Miyoshi et al. discloses a semiconductor device using the porous insulating film according to claim 11 as a layer insulating film of a multilayer wiring [0002-0003].

Regarding claim 17, Gates et al. discloses wherein in the vicinity of a interface between the porous insulating film (44) and a non-porous insulating film (72), a relative concentration of carbon atom in at least the porous insulating film changes stepwise or continuously [0044].

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Regarding claim 19, Miyoshi et al. discloses said cyclic organic silica compounds are cyclosiloxane monomers represented by said formula (2), where R1 and R2 are any one selected from the group consisting of hydrogen, an alkyl group, an alkoxide group, an amino group, alkene, alkyne, a phenyl group and a phenol group, provided that R1 and R2 may be the same or different, provided that at least one of side chain groups is an unsaturated hydrocarbon group, and n is an integer of 2 or more [0044].

Regarding claim 20, Miyoshi et al. discloses said cyclic organic silica compounds are tetravinyltetramethylcyclo-tetrasiloxane monomers represented by said formula (4) [0044].

Regarding claim 21, Miyoshi et al. discloses said cyclic organic silica compounds are trivinylcyclotrisiloxane derivative monomers represented by said formula (3) [0044].

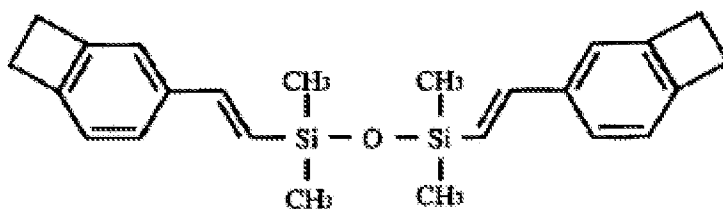
10. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gates (US Pub no. 2005/0276930 A1) in view of Miyoshi (US Pub no. 2004/0253777 A1).

Regarding claim 8, Gates et al. discloses all the claim limitations of claim 2 but fails to teach wherein said cyclic organic silica compounds are tetravinyltetramethyl-cyclotetrasiloxane monomers represented by the formula (4) and said straight-chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers represented by the following formula (5).

However, Miyoshi et al. discloses wherein said cyclic organic silica compounds are tetravinyltetramethyl-cyclotetrasiloxane monomers

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represented by the formula (4) and said straight-chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers represented by the following formula (5) [0044][0047]:



(5) Divinylsiloxanebenzocyclobutene

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the precursors of Gates et al. with cyclic organic silica compounds are tetravinyltetramethyl-cyclotetrasiloxane monomers represented by the formula (4) and said straight-chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers as taught by Miyoshi et al. since doing so would provide an insulation film having a desired low dielectric property.

11. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gates (US Pub no. 2005/0276930 A1) in view of Miyoshi (US Pub no. 2004/0253777 A1).

Regarding claim 22, Gates et al. discloses all the claim limitations of claim 18, but fails to teach said straight chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers represented by said formula (5).

However, Miyoshi et al. discloses wherein said straight chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers represented by said formula (5). [0044][0047]: It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the precursors of Gates et al. with said

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straight chain organic silica compounds are divinylsiloxanebenzocyclobutene monomers represented by said formula (5) as taught by Miyoshi et al. since doing so would provide an insulation film having a desired low dielectric property.

12. Claims 24-26 & 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fujita (US Pub no. 2004/0135254 A1) in view of Miyoshi (US Pub no. 2004/0253777 A1).

Regarding claim 24, Fujita et al. discloses all the claim limitations of claim 23 but fails to teach a ratio of elements in the film is C/Si = 1.5 to 10.0.

However, Miyoshi et al. discloses wherein ratios of elements in the film is: C/Si = 1.5 to 10.0 (tetravinyltetramethylcyclo-tetrasiloxane $C_{12}H_{24}O_4Si_4$) [0044]. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Fujita et al. with a ratio of elements in the film is C/Si = 1.5 to 10.0 as taught by Miyoshi et al. since doing so would provide an insulation film having a desired low dielectric property and porosity.

Regarding claim 25, Miyoshi et al. discloses a ratio of elements in the film is O/Si = 0.8 to 1.2 (tetravinyltetramethylcyclo-tetrasiloxane $C_{12}H_{24}O_4Si_4$) [0044].

Regarding claim 26, Miyoshi et al. discloses a ratio of elements in the film is H/Si = 4.0 to 15.0 (tetravinyltetramethylcyclo-tetrasiloxane $C_{12}H_{24}O_4Si_4$) [0044].

Regarding claim 28, Miyoshi et al. discloses the porous insulating film according to claim 23 comprising three membered silica (tetravinyltetramethylcyclo-tetrasiloxane $C_{12}H_{24}O_4Si_4$) [0044].

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Response to Arguments

13. Applicant's arguments with respect to claims 1-22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LATANYA CRAWFORD whose telephone number is (571)270-3208. The examiner can normally be reached on Monday-Friday 7:30 AM -5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Landau can be reached on (571)-272-1731. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/LaTanya Crawford/
Examiner, Art Unit 2813

/W. David Coleman/
Primary Examiner, Art Unit 2823